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Homo sapiens is generally considered to be, above all else, a visually oriented species, with other senses viewed more as supporting players than as star performers. This "bias" in perceived sensory function has had the historical consequence of casting the auditory modality in to the "back seat" of both experimental and computational neuroscience for many decades. Or so it would appear. In actuality, auditory neuroscience has typically been at the vanguard of both disciplines for well over a century.

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Joan Bosgs
STINFO Program Manager

Preface

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"The purpose of computing is insight, not numbers."

Richard Hamming

Homo sapiens is generally considered to be, above all else, a visually oriented species, with the other senses viewed more as supporting players than as star performers. This "bias" in perceived sensory function has had the historical consequence of casting the auditory modality into the "back seat" of both experimental and computational neuroscience for many decades. Or so it would appear.

In actuality, auditory neuroscience has typically been at the vanguard of both disciplines for well over a century. Such scientific landmarks include:

- (1) the first biological application of Fourier's theorem (Ohm, 1843)
- (2) the first systematic application of electrical recording technology in sensory neurophysiology (Wever and Bray, 1930).
- (3) the original use of micro-electrodes for recording the electrical activity of single neurons (Galambos and Davis, 1943)
- (4) the initial application of computer technology for presenting experimental signals (Goldstein et al., 1959)
- (5) the original utilization of computers to collect and analyze neurophysiological data (Kiang, 1965)
- (6) the first application of entirely digital technology for signal presentation, data collection and analysis (Rhode and Olsen, 1976)
- (7) the first likely application of non-linear modeling of behavioral function (Chistovich et al., 1965)

As we enter the twenty-first century (as well as the third millennium) the dawn of a new scientific era is approaching, one that melds traditional experimental and descriptive methodology with the emerging power of computational and quantitative approaches. This NATO Advanced Study Institute (ASI) serves to define the shape, texture and scope of this important, new field of scientific inquiry, as well as to delineate its likely technological contribution to such fields as telephony, automatic speech recognition, hearing prostheses, speech synthesis, high-quality voice/audio communication and reproduction.

Over the course of ten days the ASI will survey the traditional domains of hearing research, ranging from the anatomy and physiology of the auditory pathway to the perception of speech and music under both ideal and not-so-ideal (but more realistic) acoustic conditions. The intent of this survey is to provide a solid empirical basis for the sorts of computational modeling and analysis that will increasingly dominate hearing research (as well as most other varieties of scientific endeavor). In tandem with the presentation of this traditional material will occur a discussion and demonstration of computational approaches to hearing that are only just beginning to emerge from scientific laboratories in any degree of quantity and scope. The ASI's intent is to provide a rigorous, scientific overview of auditory function in concert with a critical examination of specific strategic issues that hold the key to understanding how the brain portrays the world in terms of sound. It is our hope that this ASI will provide a platform for the rapid evolution of this newly emerging discipline and thereby establish yet another landmark in our field — the first scientific meeting to focus on the melding of computational approaches with the traditional venues of auditory neuroscience and psychoacoustics.

In order to accomplish these goals we have enlisted the assistance of over a hundred of the keenest scientific minds. These individuals hail from premier laboratories around the world. The extent to which this ASI succeeds is a consequence of their efforts in providing the expertise, rigor and insight required to develop new intellectual paradigms and technological breakthroughs characteristic of scientific fields in the making. We would like to express our appreciation and gratitude to the ASI Faculty for their willingness to devote a significant proportion of their time to developing the lecture and demonstration materials, as well as to travel to a remote (albeit, stunningly beautiful) part of Northern Italy to engage their colleagues in scientific dialogue. We are also grateful to those participants who have agreed to serve as session chairs and discussants, for this role requires intense focus as well as time to prepare the session's structure and organization. Phil Green and Gerald Langner, in their capacity as the European members of the organizing committee, have provided much useful advice and help at many stages of the ASI's development, for which we are extremely grateful.

This Proceedings comprises 46 scientific communications. These papers are of exceptional quality and range in topic from the physiology of various parts of the auditory pathway, to auditory prostheses,

speech and audio coding, computational models of pitch and timbre, the role of periodicity and place mechanisms for representing complex sounds, as well as a consideration of the means by which the brain makes sense of the acoustic landscape. Most of these papers will also be presented in poster format during the course of the ASI.

No scientific meeting of any appreciable size and scope can occur without the dedicated efforts of many individuals and organizations, and this ASI is no exception. NATO provided the lion's share of funding required to support the meeting. We are grateful to that organization's Office of Scientific and Environmental Affairs for its support and guidance over the past two years. We are particularly indebted to Dr. L. Veiga da Cunha, director of the Advanced Study Institute Program at NATO. We are also grateful to the Turkish and Portuguese divisions of NATO for providing additional financial support to defray the travel expenses of participants from these countries.

This meeting also received generous financial support from the Office of Naval Research (U.S.) and the Air Force Office of Scientific Research (U.S.), for which we are deeply appreciative. We thank, in particular, Dr. Harold Hawkins of ONR and Dr. John Tangney of AFOSR for their efforts in supporting the ASI. We are also grateful for the support of the National Science Foundation (U.S.) which subsidized the travel of several of the younger American scientists. We thank Ms. Rosa Knox and Dr. Robert Metcalfe of that foundation's Graduate Education and Research Development office for their support and assistance.

We would also like to thank Barbara and Tilo Kester of International Transfer of Science and Technology (Brussels) who work closely with NATO to provide the infrastructural support for Advanced Study Institutes. The Kesters suggested Il Ciocco in Tuscany as the site most ideal for the purposes of the ASI and helped to coordinate our initial contacts with the hotel and conference center. Bruno Gianassi of Il Ciocco has provided a tremendous amount of assistance and advice in his capacity as our primary liaison with that location. We truly appreciate his patience and understanding through the long, arduous process of developing the ASI structure and for taking care of the accommodations, tours, conference facilities and the like.

We are grateful to Sun Microsystems for lending two workstations for the demonstration of computational models during the ASI. We thank Roya Ulrich and Matteo Viviano for arranging the loan of this equipment. The Mathworks generously consented to provide a number of temporary licenses for their popular Matlab program in order that various demonstrations utilizing this programming environment could be shown at the ASI.

Keith Ponting and David Stork, in their capacity as ASI Directors, Emeriti (of the Speech Patterning and Speechreading ASIs, respectively) gave willingly of their time and hard-earned wisdom. Their wise counsel and advice made the task of organizing the ASI much easier than it otherwise would have been. We would also like to thank Laura Dimario (Interval Research) for her help in the printing of the Proceedings and the ASI course reader, as well as Golan Levin (also of Interval) who designed the Proceedings cover.

Steven Greenberg
Malcolm Slaney

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